Form ESA-B4. Public Report for ESA-117-3
Final

Company	United States Steel Corporation	**ESA Dates**	6/11/08 – 6/13/08
Plant	Fairfield Works	**ESA Type**	Pumping Systems
Product	Steel Products	**ESA Specialist**	Steve Bolles

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

The U. S. Steel - Fairfield Works facility produces approximately 2.4 million tons of raw steel annually that includes hot rolled, cold rolled, and galvanized sheet products for metal building component customers and billets for the U. S. Steel - Fairfield Tubular Operations facility.

Objective of ESA:

The goal of the ESA was to apply the PSAT program, associated screening, measurement, and analysis methodologies to several pumping systems in order to:

a) Train plant personnel on the use of the DOE tools and methods
b) Identify savings potential in the selected systems and perform a preliminary evaluation of the cost-effectiveness of implementing projects to reduce energy consumption.

Focus of Assessment:

Before starting the assessment, the pump specialist and facility staff reviewed facility pump systems to determine which pumps would be the best candidates for improvement. Pump systems evaluated included:

- Dolomite Water Supply Pumps
- Generator Circulating Pumps
- Hot Strip Roll Cooling Pumps
- Hot Strip De-Scale Pumps
- Q-BOP Scrubber Water Supply Pumps
- Slab Caster Cooling Pump System

The pumps were selected based on size and opportunity for improvement.

Approach for ESA:

<u>General</u>

Ken Mills and Jason Parham coordinated the Pump ESA effort. ESA training participants included Paul Allbritton, Bryan French, Jason Braxton, Ralph Shaw and Lucas Jones.

<u>Field Measurements</u>

Dolomite Water Supply Pumps

Four 1250 hp double suction pumps are used to transfer mill water throughout the facility for process systems. Normally the facility operates two to three of these pumps in parallel. Pump TDH was determined from discharge pressure readings using existing pressure instrumentation and suction pond level. Amperage and flow measurements were taken from the plant control system for each pump. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Generator Circulating Pumps

The facility has three 500 hp generator circulating pumps to circulate water up to the cooling tower through the generator condensers and back to the suction of the pumps. The facility typically operates one pump for each generator (two generators typically on-line). Pump TDH was determined from suction and discharge pressure readings using existing pressure instrumentation. Power measurements were taken at the MCC using existing power monitors. Unfortunately flow could not be measured or even estimated since a pump curve was not available.

Hot Strip Roll Cooling & De-Scaler Pumps

The facility uses five 800 hp pumps for the roll cooling system and three 1750 hp primary pumps / two 2250 hp booster pumps for the de-scale system. For our evaluation, we evaluated one of the 800 hp pumps since we were able to get a good flow measurement on the pump discharge. Pump TDH was determined from suction and discharge pressure readings using existing pressure instrumentation. Power measurements were taken at the MCC using existing amperage and voltage meters and flow was obtained using a Panametrics portable ultrasonic flow meter. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Q-BOP Scrubber Water Supply Pumps

The facility has six 150 hp scrubber water supply pumps that distribute water to the furnace scrubbers. The facility typically operates three pumps to provide adequate system flow. Pump TDH was determined from existing discharge pressure instruments and suction pressure was estimated based on tank level. Power measurements were taken using existing pump amperage meters, and flow was determined from existing system flow meters. The data was entered into the PSAT software tool to determine existing system efficiency and evaluate potential system improvements.

General Observations of Potential Opportunities:

2007 Plant Annual Operating Energy Data

	kWhs	**MMBtu**		
Electricity	693,251,184			
Natural Gas		9,051,600		
Total	**693,251,184**	**9,051,600**		

Specific Opportunities Observed

Dolomite Water Supply Pumps

The Dolomite water pumps provide mill water for various process systems throughout the plant. The pumps draw process water from a settling pond and pump it throughout the facility. Pressure is maintained through the use of a high elevation reservoir at the far end of the water system (designated as the Wylam Reservoir). The use of a reservoir has provided a system buffer to allow pumps to be taken off line when a designated pressure is reached. Several years ago the facility was able to use the reservoir to reduce typical pump operation from three pumps to two. We reviewed several of the systems served by the Dolomite water supply system and found that maintaining system pressure was critical to insure booster pump systems had adequate pressure for each process. Based on this, we focused our analysis on pump system efficiency determined from flow, pressure and amperage readings (6800 V power supply) from the facility DCS.

The PSAT results indicated an average existing pump efficiency of 66% and estimated savings of $220,700 if pump efficiency could be restored to 85% by rebuilding two of the existing pumps or installing more efficient units. Based on an estimated project cost of $400,000 for installing two new pumps, simple payback would be approximately 1.8 years. However, before proceeding with the project we recommend installing permanent power monitors to verify existing system power use and consider testing motor efficiency (due to the age of the motors) to verify that the identified efficiency losses are from the pump.

Generator Circulating Pumps

The 500 hp generator circulating pumps direct water up to the cooling tower through the generator condensers and back to the suction of the pumps. Although we were not able to collect enough system data to determine if the pumps were properly matched to system conditions, we were able to calculate TDH from pressure measurements and determine kW from existing panel mounted power meters. However, without a flow meter (or a pump curve) we could not determine flow to calculate pump efficiency. Since the annual energy cost of operating two pumps is approximately $500,000, we believe it would be worthwhile to invest in a permanently installed flow meter for each pump.

Roll Cooling and De-Scale Pumps

The roll cooling system is separated into two cooling systems. The first uses one of the 800 hp pumps to provide approximately 6,000 gpm @ 178 psi discharge pressure. The second system uses two pumps in parallel to provide approximately 12,000 gpm @ 220 psi. Although we were able to get pressure and amperage for all the pumps, we were only able to get a flow measurement on the one pump operation where we measured 6,500 gpm at 297' TDH and a 58 amp power draw. A review of the original pump curve revealed that the pump was operating at the end of the head curve with a much lower capacity. Using the PSAT tool, the collected data corresponded to a pump efficiency of 60% compared to an original pump efficiency of over 80%. Based on these results we have recommended replacing the existing pump with one more closely matched with system requirements and a higher efficiency. Using an estimated project cost of $80,000 and calculated annual savings of $117,000 (84% new pump efficiency), the project is expected to have a simple payback of less than one year.

The de-scale pump system provides a high pressure spray used for steel de-scaling. Typical operation consists of using two 1750 hp primary pumps and one 2250 hp booster pump in series to produce approximately 6000 gpm @ 2000 psi. For this system we were able to get amperage and pressure measurements but could not get a flow reading using the portable ultrasonic flow meter. Although the facility has explored replacing all three pumps with a barrel-type pump in the hope of reducing maintenance costs and reviewed the application of a variable speed drive to reduce pump energy use when the spray water is cycled on and off, both of these projects did not prove to be cost effective.

Given that annual energy cost for the roll cooling and de-scale pump systems are over $2,000,000 annually, we recommend installing ultrasonic flow meters and power meters at the MCC to monitor pump efficiency on a regular basis. It would also be beneficial to include a data logging feature for the de-scale pumps as part of the power monitor to perform a more detailed analysis of system loading and unloading and to re-investigate the application of a variable speed drive when more data is collected. A hot strip steel plant in South Wales realized a simple payback of less than one year by applying medium voltage variable speed drives to their de-scale pumps.

Q-BOP Scrubber Supply Pumps

The facility has six 150 hp scrubber water supply pumps that distribute water to the Q-BOP furnace scrubbers. The facility typically operates three pumps to provide adequate system flow with a control valve to maintain approximately 2100 gpm through each scrubber. When the lines have been cleaned out, the control valve is typically 50% open. As the lines accumulate scale and capacity is reduced, the control valves are opened up more. Although we were not able to get readings on either side of the control valve, we evaluated system efficiency based on pressure, flow and amperage readings of the three pumps on line from the facility DCS. Based on this data, the combined efficiency of the pumps was determined to be 71% using the PSAT software. If pump efficiency could be improved to 85% and the pump discharge control valve removed (assuming an average 20 psi pressure loss), it would reduce energy costs by approximately $64,000. We recommend replacing three of the existing pumps with one large pump (250 hp) equipped with a variable speed drive. The new pump would be matched for the system conditions and be able to adjust flow to maintain the required flow rates without the need for the control valve. Based on an estimated project cost of $120,000, this project would pay for itself in 1.9 years.

Slab Caster Pumps

Due to time constraints we did not have time to review the multiple pumps for the slab caster process. However, we did meet with facility staff and discussed the information needed to evaluate the pump systems. We anticipate that when this information is assembled, facility staff that participated in the ESA will be able to evaluate the pump systems for energy saving opportunities by using the PSAT software and applying the techniques demonstrated as part of the assessment training.

General Comments

In addition to the recommendations discussed above we recommend the following initiatives:

- Purchase test equipment (flow meter, kW meter and pressure transducer) and perform pump efficiency tests as part of routine maintenance.
- Install pressure taps with isolation valves on the suction and discharge of pump systems to measure pressure.
- For all medium voltage pump systems, install power monitors (such as the ones installed on the generator circulating pumps).

Management Support and Comments:

The staff was very supportive of the effort and provided the assistance needed to conduct the assessment.

DOE Contact at Plant/Company:

Facility contact: Jason Parham Corporate contact: Ken Mills